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Exploring the Usage of MOOCs in Higher Education Institutions:
Characterization of the Most Used Platforms

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ABSTRACT

This article analyses the current usage of Massive Open Online Courses (MOOCs) in HEIs. First, a literature review is performed to identify and classify the recent developments in the area and to characterize the most used platforms and courses. Following this, an analysis of MOOCs offered by some HEIs is carried out to characterize and compare the courses available in the platforms. Concerning the main findings, the literature reveals that usage of MOOCs has been growing in recent years and that Coursera and EdX are the two main platforms used. The analysis of MOOCs available in those platforms shows that the number of universities using them and the number of courses offered have been increasing. The comparison between the courses available through the above-mentioned platforms shows that EdX is more interdisciplinary. The outcomes of this article are valuable for researchers on ICT use in HEI and may help professors implementing MOOCs in their own environment.

KEYWORDS

Coursera, EdX, Higher Education, MOOCs

1. INTRODUCTION

Higher Education Institutions (HEIs) are becoming more receptive to integrating new technologies into their teaching and learning processes, with Massive Open Online Courses (MOOCs) platforms being one of the most recent.

The MOOC is a concept associated with e-learning (Fini, 2009) and offers world class education to an unlimited number of participants (massive) around the globe with Internet access (online) for low or no fees (Aboshady et al., 2015; Glance, Forsey & Riley, 2013). MOOCs make use of some traditional course materials such as videos or short videos combined with formative quizzes, texts and problem sets, using tools for interaction, in order to build a community of students and lecturers (Ahlberg, 2014). In these courses, it is also possible to implement formative quizzes, automated assessment, peer and self-assessment and online forums for support and discussion (Glance et al., 2013). Therefore, they can offer educational benefits to HEIs, professors and students (Aboshady

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et al., 2015), providing opportunities for thousands of learners to participate in free online courses (Ahlberg, 2014; Yousef, Chatti, Wosnitza & Schroeder, 2015).

Hew and Cheung (2014, p. 51) refer to three main differences between MOOCs and traditional classroom courses: "the large and diverse student enrolment in MOOCs, the high dropout rate of MOOCs compared to that of traditional courses, and the relatively lack of instructor presence or support in MOOCs compared to traditional courses". Concerning the comparison between MOOCs and traditional e-learning courses, it is recognized that MOOCs involve more self-directed learning than other e-learning courses, and that the central role of the mediator is more recognised in traditional e-learning courses than in MOOCs (Nyoni, 2013).

The underlying technology of MOOCs is recent. The first MOOC was launched in 2008 (Ahlberg, 2014; Fini, 2009) and in 2011 there was a 'wave of offers' of MOOCs (Tschofen & Mackness, 2012). At present, HEIs are offering a growing variety of MOOCs (Yousef et al., 2015), using different platforms.

This paper aims to analyse the current usage of MOOC platforms by HEIs. This analysis was performed in two phases: the first one consisted of a literature review performed in order to (1) identify and classify the published works and the recent developments in this area, (2) identify the most popular MOOC platforms, and (3) characterize the most used platforms and courses based on the practical cases reported in the literature. The second phase involved the analysis of MOOCs offered by some of the most recognized HEIs around the world, in order to characterize and compare the courses available in the two most popular MOOC platforms.

The paper is organized in four sections. The MOOC concept was outlined in this introductory section. The characterization of the most popular MOOC platforms through data from a systematic search is described in the second section and, in the third section the most used MOOC platforms in HEIs are characterized through the data collected. Finally, in the fourth section, some conclusions and directions for future work are presented.

2. CHARACTERIZATION OF THE MOST POPULAR MOOC PLATFORMS THROUGH A SYSTEMATIC SEARCH

In this section, the research method of the literature revision and a brief characterization of the articles considered relevant are presented (section 2.1). In section 2.2, the most mentioned MOOC platforms in the selected articles are identified and the two most often referred to are characterized.

2.1. Selection and Characterization of the Selected Articles

The methodology followed in the first part of the study was a systematic literature review covering the years from 2008 to 2015, since the first MOOC appeared in 2008 (Ahlberg, 2014; Fini, 2009).

In order to gather data about published MOOC literature, the most specialized scientific databases in the areas of Information and Communication Technologies (ICT) and Education were selected, which were (1) ISI Web of Knowledge; (2) Scopus and (3) IEEE Xplorer.

The selected search terms were: (1) MOOC; (2) massive open online course; (3) higher education; (4) university and (v) universities. The search was performed in the title, in the abstract and in the keywords and the search expression used was (MOOC OR "massive open online course") AND ("higher education" OR university OR universities).

An overview of the documents identified is presented in Table 1. The first column identifies the database used in each search; the 2nd column presents the resulting number of documents (article, review, conference paper, book, book chapter, editorial) and, in the 3rd column, the resulting number of the document types considered in this work – article or review, from now on named 'article'.

It should be emphasized that some of the articles are common to more than one database. The data collection resulted thus in 279 articles, 54 only from ISI Web of Knowledge, 132 only from Scopus, 1

Table 1. Search documents in academic databases

Database	Total Number of Documents	Number of Documents Considered – Articles
ISI Web of Knowledge	316	155
Scopus	479	229
IEEE Xplorer	148	10

only from IEEE Xplorer, 83 from ISI Web of Knowledge and Scopus, 3 from ISI Web of Knowledge and IEEE Xplorer, 2 from Scopus and IEEE Xplorer, and 4 from all the three databases (Figure 1).

The articles identified were then analysed according to the year of publication, the journals where they were published and the respective authors.

Figure 2 presents the number of articles published on MOOCs in the databases analysed, per year, from January 2012 until December 2015 (although the search was performed using 2008 as starting year, the first articles were published in the year 2012), and it can be seen that this number has been increasing consistently through this period of time.

Concerning the number of journals, by the end of 2015 there were 166 scientific journals of the 3 selected databases that published articles about MOOCs. Of these, 162 had published less than 7 articles. Among the other 4 journals, the 'International Review of Research in Open and Distance

Figure 1. Number of articles found in the three academic databases

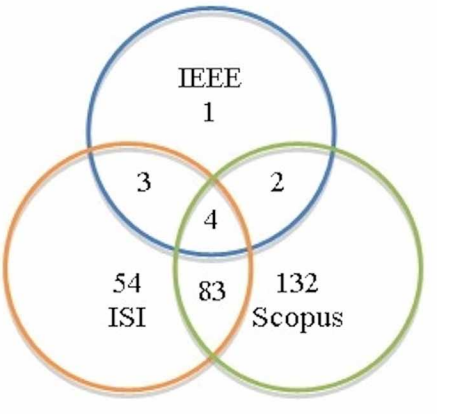
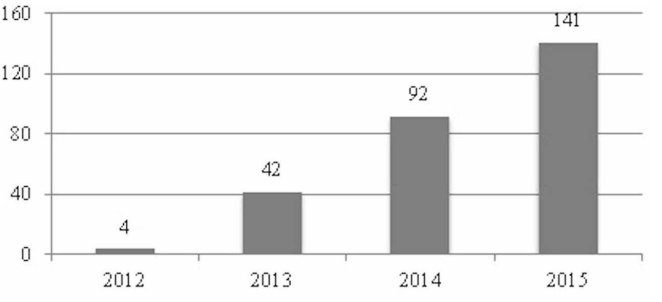


Figure 2. Number of articles by publication year



Learning' published 32 articles, 'Profesorado' and 'RUSC Universities and Knowledge Society Journal' published 9 and 'Distance Education' published 8 articles.

An analysis of the number of articles by author has also been made. The authors that presented the highest number of publications (three) are Ramirez-Fernandez, Meneses, Rhoads, Toven-Lindsey and Vazquez Cano. According to Lopez-Meneses, Vazquez-Cano, & Roman (2015), Forsey and Glance are the most cited authors. In this analysis, these two authors have two articles each.

The 279 relevant articles characterized above were then analysed in order to identify the most mentioned MOOC platforms.

2.2. Identification and Characterization of the Most Mentioned MOOC Platforms in the Selected Articles

The criterion used to identify the most mentioned MOOC platforms in the scientific literature was to select those referred to in more than four articles. This analysis resulted in 11 different platforms from a total of 52. Then, the articles that referred to at least one of those 11 platforms were considered, with 182 articles emerging. Table 2 presents the number of articles that mention each of the 11 platforms.

It can be noticed that the most referenced platforms are Coursera and EdX. This result is in line with the study by Kim (2015), which states that these two platforms are the most widely used ones.

In order to characterize the most popular MOOC platforms in terms of (1) universities that use them, (2) courses offered, and (3) participants in those courses, the 182 articles were subjected to a further selection procedure that took into account various criteria (see Figure 3).

According to Figure 3, 40 articles were found that characterize the Coursera or EdX platforms that were used in the following stage of this study. From these articles, 33 report empirical studies and the remaining 7 focus on a theoretical approach (review studies). Content analysis was performed on these articles in order to identify the features of the Coursera and EdX platforms concerning four categories: universities, courses, participants, and recourses/activities of MOOCs. Table 3 presents the features related to universities: number, name and localization of universities that offer MOOCs.

It can be noticed that the number of universities that offer MOOCs increased from 2012, where there were 36 universities offering MOOCs in Coursera and 3 in EdX (Audsley et al., 2013) and 2013 where there were 80 identified in Coursera and 29 in EdX (Atenas, 2015). Liyanagunawardena & Williams (2014) and Subhi et al. (2014) highlight that the universities offering MOOCs are heavily concentrated in the USA.

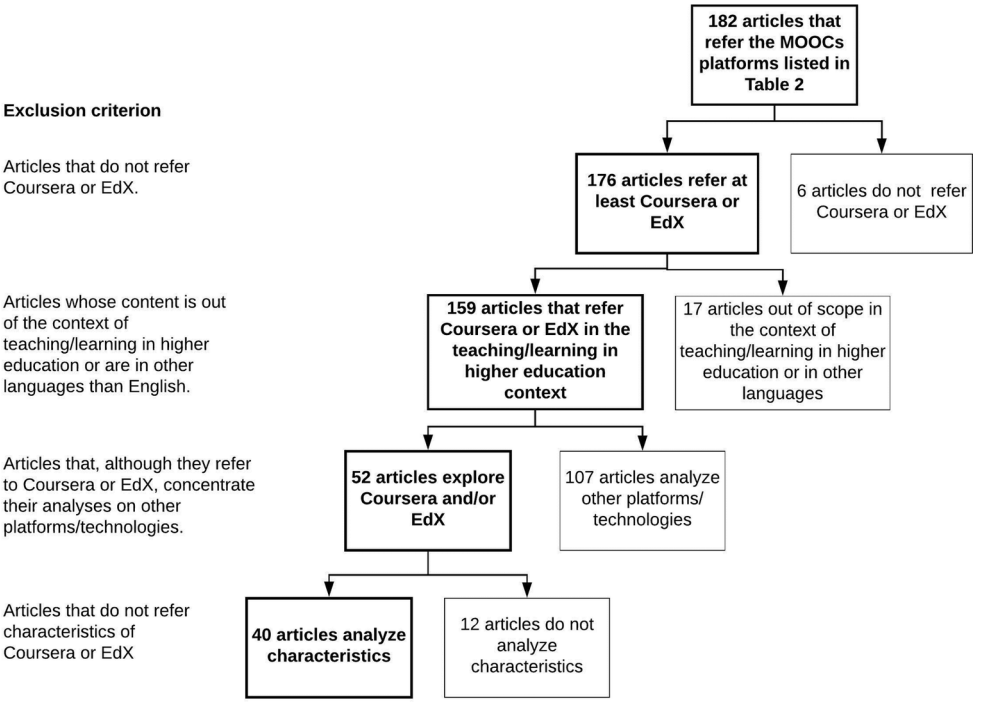
Table 4 presents the number of courses offered in the Coursera and EdX platforms.

It can be inferred from Table 4 that the number of MOOCs has been increasing. It can be observed that in 2012 there were 198 Coursera courses and 9 EdX courses (Audsley et al., 2013), in 2013 there were 556 courses in Coursera and 112 in EdX (Subhi et al., 2014), in 2014 Coursera offered 664 courses and EdX 182 (Brahimi & Sarirete, 2015), and in June 2015 there were 1041 Coursera courses and 611 in EdX (Lin et al., 2015).

Table 2. Number of articles mentioning each MOOC platform

	Total	Cousera	EdX	Udacity	FutureLearn	MiriadaX	Udemy	Iversity	OpenupEd	Open2Study	Canvas	Khan Academy
Number of articles	182	162	145	107	37	14	13	11	11	11	7	6

Figure 3. Method used to select the articles that characterize Coursera or EdX



The courses covered many areas of knowledge, from health sciences to arts, music or technology (Audsley et al., 2013; Brahimi & Sarirete, 2015; Dillahunt et al., 2014; Macleod et al., 2015; Perna et al., 2014; Toven-Lindsey et al., 2015; Vazquez-Cano, 2013), their duration varied between 3 to 20 weeks (Admiraal et al., 2015; Engle et al., 2015; Kustritz, 2014; Liyanagunawardena & Williams, 2014; Najafi et al., 2014; O'Malley et al., 2015; Redfield, 2015; Subhi et al., 2014) and they required 2 to 15 hours of work per week (Admiraal et al., 2015; Audsley et al., 2013; Dillahunt et al., 2014; Haggard, 2013 in Atenas, 2015; Subhi et al., 2014). The number of instructors involved in the courses varies between 1 and 13 (Perna et al., 2014).

The number of people using the platforms were, in November 2014, more than 10 million students using Coursera and more than 1.7 million students using EdX (Kim, 2015). The localization of the courses' participants was highly varied (Bayne, 2015; Hood et al., 2015; Severance, 2015; Soffer & Cohen, 2015).

However, the United States had many more students that the other countries (Fricton et al., 2015; Kustritz, 2014; Macleod et al., 2015). The age of participants was mostly between 24 and 34 (Dillahunt et al., 2014; Gillani & Eynon, 2014), the gender prevalence was largely related to the subject matter (Macleod et al., 2015) with more females than males in general (Fricton et al., 2015; Jiang et al., 2014; Kustritz, 2014; Murray, 2014) and the majority of the participants were undergraduate students (Dillahunt et al., 2014; Engle et al., 2015; Fricton et al., 2015; Gillani & Eynon, 2014; Schmid et al., 2015).

Some resources/activities used in Coursera were videos, quizzes (Egerstedt, 2013; Woodgate et al., 2015) and discussion forums (Burch & Harris, 2014; DeBoer et al., 2014; Egerstedt, 2013; Gillani & Eynon, 2014; Woodgate et al., 2015) and some of the courses also used Facebook and Google + groups (Knox, 2014).

Table 3. Main features related to universities that offer MOOCs in Coursera and/or EdX

Number of universities that offer MOOCs in Coursera	**Number of universities that offer MOOCs in EdX**	**Reference**
36 universities in 2012	3 universities in 2012	(Audsley et al., 2013)
61 universities in 2013		(Clarke, 2013)
70 universities in 2013		(Baggaley, 2013)
80 universities in 2013	29 universities in 2013	(Atenas, 2015)
90 universities	30 universities	(Perez & Guzman-Duque, 2015)
Identification of universities that offer MOOCs in Coursera	**Identification of universities that offer MOOCs in EdX**	**Reference**
Leiden University: 3 MOOCs in 2013-2014		(Admiraal et al., 2015)
University of Pennsylvania: 16 MOOCs		(Ruby et al., 2015)
Duke University: 13 MOOCs in 2014		(Schmid et al., 2015)
University of Edinburgh: 1 MOOC		(Bayne, 2015)
Duke University: 1 MOOC		(Engle et al., 2015)
Identification of universities that offer MOOCs in Coursera and EdX		**Reference**
Johns Hopkins University, University of Pennsylvania, Duke University, University of California – San Francisco, Harvard University, Stanford University, Berkeley, and University of Toronto: 73 MOOCs		(Subhi et al., 2014)
John Hopkins University, University of California, University of Pennsylvania, Open Universities Australia, Harvard University, and University of Sheffield: 40 MOOCs on "Health and Medicine"		(Liyanagunawardena & Williams, 2014)
Localization of universities that offer MOOCs in Coursera	**Localization of universities that offer MOOCs in EdX**	**Reference**
USA, France, Switzerland, Israel, Germany, Taiwan, Singapore, Italy, Denmark, Mexico, Hong Kong, Scotland, Japan, Spain, and Australia		(Clarke, 2013)
USA, UK and Germany: 12 MOOCs in 2013		(Nkuyubwatsi, 2014)
Netherlands: 3 MOOCs in 2013-2014		(Admiraal et al., 2015)
Localization of universities that offer MOOCs in Coursera and EdX		**Reference**
North America, Europe, and Australia: 59 MOOCs		(Subhi et al., 2014)

Table 4. Summary of the main features of courses in Coursera and/or EdX

Number of Courses in Coursera	Number of Courses in EdX	Reference
57 courses on health and medicine	5 courses on health and medicine	(Liyanagunawardena & Williams, 2014)
60 courses on bioinformatics and computational biology	12 courses on bioinformatics and computational biology	(Searls, 2014)
198 courses in 2012	9 courses in 2012	(Audsley et al., 2013)
542 courses in 2013	91 courses in 2013	(Atenas, 2015)
556 courses in 2013	112 courses in 2013	(Subhi et al., 2014)
600 courses	170 courses	(Perez & Guzman-Duque, 2015)
664 courses in 2014	182 courses in 2014	(Brahimi & Sarirete, 2015)
839 courses	415 courses	(Nisha & Senthil, 2015)
1041 courses in 2015	611 courses in 2015	(Lin et al., 2015)

Only a small percentage of the students involved completed the course (Engle et al., 2015; Fricton et al., 2015; Gillani & Eynon, 2014; Jordan, 2014; Murray, 2014; Soffer & Cohen, 2015) and got the respective certificate (Aboshady et al., 2015; Admiraal et al., 2015; Dillahunt et al., 2014; Egerstedt, 2013; Jiang et al., 2014).This can be explained by the fact that most of the students want just to explore the specific topic of the course rather than complete it (Koller et al., 2013 in Murray, 2014).

An analysis of the MOOC platforms and a comparison between them are performed in the next section.

3. CHARACTERISATION OF THE MOST USED MOOC PLATFORMS THROUGH COLLECTED DATA

This section involves the analysis of MOOCs offered by some of the most recognized HEIs around the world, in order to characterize and compare the courses available in the two most popular MOOC platforms. The method used in order to collect the data is presented (section 3.1), followed by a brief characterization and comparison of the Coursera and EdX MOOC platforms (section 3.2).

3.1. Method Used in Collecting Data

According to the literature review, Coursera and EdX are the most referenced platforms. These platforms were then selected for a more detailed practical study that consisted of the analysis of the information available on their sites, which also allowed the characterization and comparison of courses offered through those platforms.

On 22/05/2015 information was collected about 107 courses in Coursera, and on 26/05/2015 information was collected about 115 courses in EdX.

For each platform and for each course, the data collected were: (1) name of course; (2) HEI offering the course; (3) area of knowledge; (4) whether the course presents an introductory video or not; (5) number of instructors involved in the course; (6) duration; and (7) expected workload for a student to successfully complete the course.

The collected data were analysed using the IBM SPSS Statistics 22 software. First, a descriptive analysis was performed in order to characterise the courses in the Coursera and EdX platforms. Afterwards, independent samples *t*-tests were carried out in order to understand whether there were statistically significant differences between the number of the weeks of duration, the minimum and maximum number of hours of work per week, and number of instructors of courses in Coursera and EdX.

3.2. Characterisation and Comparison of MOOCs in Coursera and EdX

The Coursera and EdX platforms were analysed considering the following criteria: (1) number of HEIs that offer courses using these platforms; (2) number of MOOCs made available by the HEIs that offer more than three courses; (3) number and areas of knowledge of the courses available through each platform; (4) percentage of courses that present an introductory video summarizing the objectives and main contents of the course; and (5) descriptive statistics of the duration of the courses, the expected workload for a student to successfully complete the MOOCs, and the number of instructors involved.

Regarding the universities using Coursera, it was found that on 19/05/2015 there were 102 universities offering 1036 courses (Coursera, 2015), while in November 2013 there were 80 universities presenting 542 courses (Atenas, 2015), and on 02/11/2012 there were 36 universities presenting 198 courses (Audsley et al., 2013). Concerning EdX, on 19/05/2015, there were 39 universities offering 516 courses (EdX, 2015), while in November 2013 there were 29 universities and 91 courses (Atenas, 2015), and on 02/11/2012 there were only three universities presenting 9 courses (Audsley et al., 2013). Taking into account the current figures, it can be seen that the relationship between the number of courses and number of universities offering the courses (NCourses/NUniversities) is higher in the case of EdX (about 13) than in the case of Coursera (about 10).

On the date of this study, it was found that more than 13 million students have signed up for courses using Coursera (Coursera, 2015). The same information from EdX was not available, but it was possible to notice that 0.4 million students obtained certificates from EdX courses (EdX, 2015). Actually, the number of students that use MOOCs in these platforms has increased substantially, since on March 2013, 2.8 million people learned through Coursera, and about 1.3 million people used EdX, and by November 2014, more than 10 million students had signed up for Coursera's courses, and more than 1.7 million students had signed up for EdX's courses (Kim, 2015).

On 22/05/2015, Coursera had 107 courses available from 54 HEIs, while EdX had, on 26/05/2015, 115 courses available from 39 HEIs. In Figure 4 it can be seen that 4 of those HEIs (Berklee College of Music, École Polytechnique Fédérale de Lausanne, Peking University and Rice University) offered courses in both platforms simultaneously.

Taking into account the number of HEIs that had courses available in May 2015, and as was already pointed out, there were 54 HEIs using Coursera and 39 HEIs using EdX. Table 5 presents the universities offering 4 or more courses.

Figure 4. Number of universities offering courses in Coursera and EdX MOOC platforms

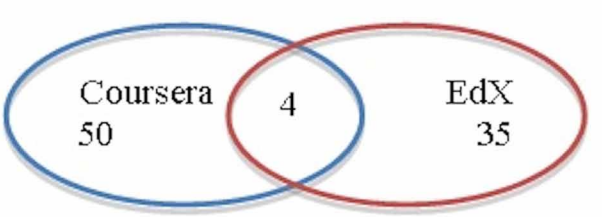


Table 5. Number of MOOCs offered by universities with 4 or more courses available

University	Number of Courses		
	Coursera	EdX	Total
Harvard University	0	26	26
Peking University	9	6	15
MIT	0	12	12
Tsinghua University	0	10	10
Universitat Politècnica de València	0	9	9
University of Pennsylvania	7	0	7
Berklee College of Music	4	2	6
University of Copenhagen	5	0	5
Cornell	0	4	4
Johns Hopkins University	4	0	4
Rice University	3	1	4
Stanford University	4	0	4
Universitat Autònoma de Barcelona	4	0	4
The University of Queensland, Australia	0	4	4

Harvard University, Peking University and MIT are the universities with more MOOCs available in the platforms studied. Note that Harvard University and MIT only have courses in the EdX platform, which confirms a higher concentration of courses per HEI in EdX than in Coursera.

Concerning the knowledge areas of the MOOCs, in the Coursera platform they are classified in 21 different categories, while in EdX the correspondent number is 23. Table 6 presents the knowledge

Table 6. Areas of knowledge of courses and number of courses on Coursera and EdX platforms

Areas of Knowledge		Coursera		EdX	
		N	%	N	%
Architecture		---	---	1	0.9
Art & Culture		---	---	4	3.5
Biology & Life Sciences		6	5.7	15	13.2
Business & Management		6	5.7	14	12.3
Chemistry		---	---	2	1.8
Communication		---	---	4	3.5
Computer Science:	Artificial Intelligence	1	0.9	17	14.9
	Software Engineering	4	3.8		
	Systems & Security	5	4.7		
	Theory	7	6.6		
Economics & Finance		13	12.3	2	1.8
Education		5	4.7	2	1.8
Electronics		---	---	5	4.4
Energy & Earth Sciences		---	---	2	1.8
Engineering		2	1.9	8	7.0
Health & Society		2	1.9	---	---
Environmental Studies		---	---	2	1.8
History		---	---	13	11.4
Humanities		13	12.3	4	3.5
Information, Tech & Design		8	7.5	---	---
Law		1	0.9	3	2.6
Literature		---	---	1	0.9
Mathematics		3	2.8	4	3.5
Medicine		17	16.0	2	1.8
Music, Film, & Audio		4	3.8	---	---
Philosophy & Ethics		---	---	1	0.9
Physical & Earth Sciences		2	1.9	---	---
Physics		2	1.9	4	3.5
Social Sciences		1	0.9	3	2.6
Statistics & Data Analysis		1	0.9	1	0.9
Teacher Professional Development		3	2.8	---	---
Total		106		114	

areas considered in each of the platforms being studied, and the number and percentage of courses classified in each one.

Many of the areas are common to both platforms. In Coursera, the areas where there are more courses are: Computer Science (17; 16.0%), Medicine (17; 16.0%), Humanities (13; 12.3%) and Economics & Finance (13; 12.3%). In EdX the corresponding areas are: Computer Science (17; 14.9%), Biology & Life Sciences (15; 13.2%), Business & Management (14; 12.3%) and History (13; 11.4%).

Toven-Lindsey et al. (2015) used Biglan's (1973) model for categorizing academic disciplines in MOOCs. According to the knowledge areas of the courses available in each platform (Table 8), a classification based on Biglan's model using the categorization of Laird, Shoup, Kuh and Schwarz (2008) was performed.

Biglan's model is a framework for studying the cognitive style of scholars in different areas. This model clusters subject matter of academic areas in three dimensions. The dimensions are: hard and soft sciences – defined by the "degree to which a paradigm exists", pure and applied – defined by "the degree of concern with application", and life and non-life – defined by "concern with life systems" (Biglan, 1973, p. 203). The categories are eight: Hard-Pure-Life, Hard-Pure-Non-Life, Hard-Applied-Life, Hard-Applied-Non-Life, Soft-Pure-Life, Soft-Pure-Non-Life, Soft-Applied-Life, Soft-Applied-Non-Life.

From this perspective, the categories that aggregate more courses are: Soft (56; 52.8%), Applied (92; 86.8%), and Non-Life (71; 67.0%) in Coursera and Hard (62; 54.4%), Applied (69; 60.5%), and Non-Life (87; 76.3%) in EdX.

Figure 5 presents the percentage of courses classified in each Biglan category for both platforms.

It can be seen in Figure 5 that the categories that encompass more courses in Coursera are Soft-Applied-Non-Life (44; 41.5%), while in EdX they are Hard-Applied-Non-Life (30; 26.3%) and Soft-Applied-Non-Life (29; 25.4%). Comparing the two platforms, it can be observed that there is a larger difference in the categories Hard-Pure-Life (more courses in EdX) and Hard-Applied-Life and Soft-Applied-Non-Life (more courses in Coursera).

With regard to the introductory video, which presents the course in an easy and fast way to provide a first contact with the content and the professor (Audsley et al., 2013), it can be observed that it is included in 93.5% of the courses found in Coursera (Coursera, 2015) and in 88.7% of the courses found in EdX (EdX, 2015).

Finally, some information regarding the duration of the courses and the expected workload for a student to successfully complete the MOOCs (with the exception of the time of attending the "lessons"), are presented.

Table 7 shows the descriptive statistics (mean, median, mode, standard deviation and data range) of the duration of the courses (in number of weeks), the courses' workload per week (in hours) and number of instructors for both platforms.

Figure 5. Percentage of MOOCs by Biglan categories in Coursera and EdX platforms

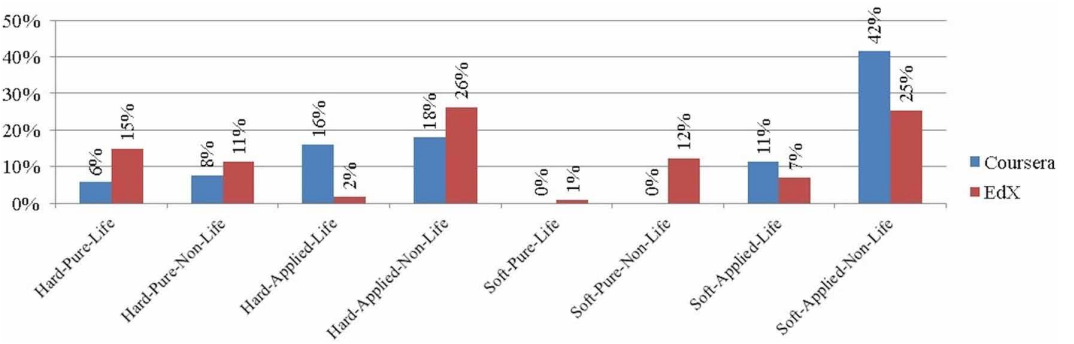


Table 7. Descriptive statistics of the duration and workload of courses, and number of instructors in both platforms

	Duration (Weeks)		Minimum (Hours)		Maximum (Hours)		Number of Instructors	
	Coursera (N = 107)	EdX (N = 111)	Coursera (N = 107)	EdX (N = 107)	Coursera (N = 107)	EdX (N = 107)	Coursera (N = 107)	EdX (N = 115)
Mean	9.38	8.37	3.93	4.14	6.10	5.07	1.76	2.70
Median	6.00	8.00	4.00	4.00	6.00	5.00	1.00	2.00
Mode	6	6	4	4	5	6	1	1
Std. Deviation	13.488	3.885	1.912	2.059	2.595	2.267	1.180	2.421
Data range	[4; 105]	[2; 17]	[1; 10]	[1; 12]	[2; 15]	[1; 12]	[1; 6]	[1; 16]

On average, the durations of the courses are 9.38 (s=13.488) weeks in Coursera and 8.37 (s=3.885) weeks in EdX. The Coursera courses are between 4 and 105 weeks long. It should be stressed that in this case there are two outliers (a course of 104 and another of 105 weeks long), that have an impact on the statistics that were calculated and on the comparison with other studies (these outliers were later removed, when the means are compared). Nevertheless, it is important to note that according to other studies, the duration of courses is 6 to 12 weeks (Perna et al., 2014) and 5 to 15 weeks (Dillahunt et al., 2014), respectively.

Regarding EdX, the courses analysed took between 2 and 17 weeks, while according to Haggard (2013 in Atenas, 2015), the MOOCs courses are usually between 4 and 10 weeks long.

On average, the minimum workload of the Coursera platform was found to be 3.93 (s = 1.912) hours per week, and the maximum was 6.10 (s = 2.595) hours per week. In EdX, on average, the minimum workload was found to be 4.14 (s = 2.059) hours per week, and the maximum 5.07 (s = 2.267) hours per week. According to Audsley et al. (2013), the average Coursera course requires 4.6 to 6.8 hours of work per week, and in EdX 10 to 15 hours per week. The discrepancy in the results of this study and the one by Audsley et al. (2013) relating the EdX platform can be explained by the fact that the latter only considered the data from 9 courses, while the former considered the data from 111. Concerning Coursera, there is no such discrepancy, since the number of courses in this platform considered by Audsley et al. (2013) was 198 versus 107 courses in this study.

In Coursera, the students dedicated between 1 and 15 hours a week to work, and in EdX between 1 and 12 hours a week. According Subhi et al. (2014), students must typically dedicate between 3 and 6 hours a week to study.

Comparing the values presented in Table 7 for courses available on both platforms, it can be observed that there are no considerable differences in the workload required to successfully complete the courses, since the intervals defined by the minimum and maximum values of workload overlap.

On average, the number of instructors is 1.76 (s = 1.180) in Coursera, and 2.70 (s = 2.421) in EdX. Most of the courses have only one (Coursera – 59.0%; EdX – 36.5%) or two instructors (Coursera – 21.5%; EdX – 29.6%). While in this study the number of instructors in Coursera was found to be between 1 and 6, according Perna et al. (2014), the corresponding number is between 1 and 13.

The comparison of means between the numbers of the weeks of duration, minimum and maximum number of hours of work per week and number of instructors in Coursera and EdX platforms were carried out using independent samples *t*-tests.

Table 8 presents some descriptive statistics (N, Mean, and Standard Deviation) of the variables considered for each platform. For each variable, the severe outliers were removed (severe outliers were considered to be values exceeding $Q3 + 3*IQR$, where $IQR = Q3 - Q1$ (Inter-Quartile Range) (Bradley, 2007).

The results of the independent samples *t*-tests for the variables in Coursera and EdX platforms are also presented in Table 8.

Table 8. Independent Samples t-tests for the number of the weeks, hours of work per week, and number of instructors in Coursera and EdX platforms

Variable	Severe Outliers Removed					
	Platform	N	Mean	SD	t	p-Value
Duration (weeks)	Coursera	105	7.57	2.852	-1.727	0.086
	EdX	111	8.37	3.885		
Minimum (hours)	Coursera	107	3.93	1.912	-0.239	0.811
	EdX	105	3.99	1.763		
Maximum (hours)	Coursera	107	6.10	2.595	3.100	0.002
	EdX	107	5.07	2.267		
Number of instructors	Coursera	103	1.61	0.931	-4.332	< 0.001
	EdX	112	2.43	1.744		

It can be observed that there are statistically significant differences between the two platforms concerning the means of the maximum number of hours of work per week and of the number of instructors (p-value < 0.05). The courses that, on average, exhibit a higher maximum number of hours of work per week are from the Coursera platform while the ones that, on average, have more instructors are from EdX. The other variables considered did not show statistically significant differences.

4. CONCLUSION

A systematic literature review about MOOCs in higher education was carried out in order to identify, classify and better understand the works published in this area. The ISI Web of Knowledge, Scopus and IEEE Xplorer databases were used in the search, considering publications since 2008. The analysis resulted in 279 articles, and it was noticed that the number of studies published in this are increased considerably in the last two years.

As Coursera and EdX platforms were the most mentioned in the referred review, a comparison of these platforms was made, using content analysis of the information available on the platforms' sites.

The number of universities using these platforms, as well as the number of courses offered has been increasing over the years. On May 2015 there were 102 universities that offered 1036 courses in the Coursera platform, while regarding EdX, on May 2015 there were 39 universities that offered 516 courses. Thus, it can be concluded that the relationship between the number of courses and number of universities offering the courses is higher in the case of EdX than in the case of Coursera.

With respect to the introductory video, it is included in 93.5% of the courses found in Coursera and in 88.7% of the courses found in EdX. Most of the courses have only one or two instructors.

The average duration of the courses in Coursera is 9.38 weeks, and in EdX is 8.37 weeks. The average course in Coursera requires 3.93 to 6.10 hours of work per week, and in EdX requires 4.14 to 5.07 hours per week.

It may be noted that EdX is more interdisciplinary than Coursera because it covers a higher number of knowledge areas. Architecture, Art & Culture, Communication, History, Literature, and Philosophy & Ethics are examples of areas present in EdX and not included in Coursera. According to Biglan's model, Coursera does not have courses in the Soft-Pure-Life and Soft-Pure-Non-Life categories. Coursera has many more MOOCs in the Soft-Applied-Non-Life category than EdX (41.5% vs 25.4%) and in Hard-Applied-Life (16.0% vs 1.8%), while EdX has more courses in Hard-Pure-Life than Coursera (14.9% vs 5.7%).

Findings show there are statistically significant differences (significance level of 5%) between Coursera and EdX platforms concerning the mean of the maximum number of hours of work per week and of the number of instructors.

It is considered that the outcomes of this work are valuable for researchers on the use of Information and Communication Technologies in Higher Education and the study can help institutions and professors to implement MOOCs in their own environment.

For future work, it is intended to complement the characterization of the two studied platforms. Additionally, it is planned to continue to study the evolution of the concept of MOOCs and their supporting platforms, and analyse other technologies that can emerge in this context.

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REFERENCES

Aboshady, O. A., Radwan, A. E., Eltaweel, A. R., Azzam, A., Aboelnaga, A. A., Hashem, H. A., & Hassouna, A. (2015). Perception and use of massive open online courses among medical students in a developing country: Multicentre cross-sectional study. *BMJ Open*, *5*(1). doi:10.1136/bmjopen-2014-006804 PMID:25564149

Admiraal, W., Huisman, B., & Pilli, O. (2015). Assessment in massive open online courses. *Electronic Journal of e-Learning, 13*(4), 207-216.

Ahlberg, C. (2014). MOOCs at Karolinska institutet university library. *Insights*, *27*(2), 160–165. doi:10.1629/2048-7754.116

Atenas, J. (2015). Model for democratisation of the contents hosted in MOOCs. *RUSC Universities and Knowledge Society Journal*, *12*(1), 3–14. doi:10.7238/rusc.v12i1.2031

Audsley, S., Fernando, K., Maxson, B., Robinson, B., & Varney, A. K. (2013). An Examination of Coursera as an information environment: Does Coursera fulfill its mission to provide open education to all? *The Serials Librarian*, *65*(2), 136–166. doi:10.1080/0361526X.2013.781979

Baggaley, J. (2013). MOOC rampant. *Distance Education*, *34*(3), 368–378. doi:10.1080/01587919.2013.835768

Bayne, S. (2015). Teacherbot: Interventions in automated teaching. *Teaching in Higher Education*, *20*(4), 455–467. doi:10.1080/13562517.2015.1020783

Biglan, A. (1973). The characteristics of subject matter in different academic areas. *The Journal of Applied Psychology*, *57*(3), 195–203. doi:10.1037/h0034701

Bradley, T. (2007). *Essential statistics for economics, business and management*. London: John Wiley & Sons.

Brahimi, T., & Sarirete, A. (2015). Learning outside the classroom through MOOCs. *Computers in Human Behavior*, *51*, 604–609. doi:10.1016/j.chb.2015.03.013

Burch, S. L., & Harris, S. E. (2014). A Massive Open Online Course on climate change: The social construction of a global problem using new tools for connectedness. *Wiley Interdisciplinary Reviews: Climate Change*, *5*(5), 577–585. doi:10.1002/wcc.300

Clarke, T. (2013). The advance of the MOOCs (massive open online courses): The impending globalisation of business education? *Education + Training*, *55*(4), 403–413. doi:10.1108/00400911311326036

Coursera. (2015). Coursera. Retrieved 19/05/2015, from https://www.coursera.org

DeBoer, J., Ho, A. D., Stump, G. S., & Breslow, L. (2014). Changing "Course": Reconceptualizing Educational Variables for Massive Open Online Courses. *Educational Researcher*, *43*(2), 74–84. doi:10.3102/0013189X14523038

Dillahunt, T., Wang, Z., & Teasley, S. D. (2014). Democratizing Higher Education: Exploring MOOC Use Among Those Who Cannot Afford a Formal Education. *International Review of Research in Open and Distance Learning*, *15*(5), 177–196. doi:10.19173/irrodl.v15i5.1841

EdX. (2015). Couresea. Retrieved 9/05/2015, from https://www.edx.org

Egerstedt, M. (2013). Controls for the masses [focus on education]. *IEEE Control Systems*, *33*(4), 40–44. doi:10.1109/MCS.2013.2258762

Engle, D., Mankoff, C., & Carbrey, J. (2015). Coursera's Introductory Human Physiology Course: Factors that Characterize Successful Completion of a MOOC. *International Review of Research in Open and Distance Learning*, *16*(2), 46–68. doi:10.19173/irrodl.v16i2.2010

Fini, A. (2009). The Technological Dimension of a Massive Open Online Course: The Case of the CCK08 Course Tools. *International Review of Research in Open and Distance Learning*, *10*(5), 1–26. doi:10.19173/irrodl.v10i5.643

Fricton, J., Anderson, K., Clavel, A., Fricton, R., Hathaway, K., Kang, W., & Whitebird, R. et al. (2015). Preventing chronic pain: a human systems approach-results from a massive open online course. *Global Advances in Health and Medicine: Improving Healthcare Outcomes Worldwide*, *4*(5), 23–32. doi:10.7453/gahmj.2015.048 PMID:26421231

Friedman, L. W., & Friedman, H. H. (2013). Using social media technologies to enhance online learning. *Journal of Educators Online*, *10*(1), 1–22. doi:10.9743/JEO.2013.1.5

Galán, J. G. (2014). The MOOC phenomenon and universality of culture: The news boundaries of higher education. *Profesorado*, *18*(1), 73–91.

Gallego-Arrufat, M. J., Gamiz Sanchez, V., & Gutierrez Santiuste, E. (2015). Trends in assesment in massive open online courses. *Educacion XX1, 18*(2), 77-96.

Gillani, N., & Eynon, R. (2014). Communication patterns in massively open online courses. *Internet and Higher Education*, *23*, 18–26. doi:10.1016/j.iheduc.2014.05.004

Glance, D. G., Forsey, M., & Riley, M. (2013). The pedagogical foundations of massive open online courses. *First Monday*, *18*(5). doi:10.5210/fm.v18i5.4350

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review, 12*, 45-58.

Hood, N., Littlejohn, A., & Milligan, C. (2015). Context counts: How learners' contexts influence learning in a MOOC. *Computers & Education, 91*, 83-91.

Jiang, S., Williams, A. E., Warschauer, M., He, W., & O'Dowd, D. K. (2014). Influence of Incentives on Performance in a Pre-College Biology MOOC. *International Review of Research in Open and Distance Learning*, *15*(5), 99–112. doi:10.19173/irrodl.v15i5.1858

Jordan, K. (2014). Initial Trends in Enrolment and Completion of Massive Open Online Courses. *International Review of Research in Open and Distance Learning*, *15*(1), 133–159. doi:10.19173/irrodl.v15i1.1651

Kim, J. I. (2015). A study on the K-MOOC platform standardization measures. *International Journal of Software Engineering and Its Applications*, *9*(1), 221–236.

Knox, J. (2014). Digital culture clash: "massive" education in the E-learning and Digital. *Distance Education*, *35*(2), 164–177. doi:10.1080/01587919.2014.917704

Kustritz, R. M. V. (2014). Canine theriogenology for dog enthusiasts: Teaching methodology and outcomes in a massive open online course (MOOC). *Journal of Veterinary Medical Education*, *41*(1), 9–18. doi:10.3138/jvme.0813-112R1 PMID:24393779

Laird, T. F. N., Shoup, R., Kuh, G. D., & Schwarz, M. J. (2008). The effects of discipline on deep approaches to student learning and college outcomes. *Research in Higher Education*, *49*(6), 469–494. doi:10.1007/s11162-008-9088-5

Lin, Y.-L., Lin, H.-W., & Hung, T.-T. (2015). Value hierarchy for Massive Open Online Courses. *Computers in Human Behavior, 53*, 408-418.

Liyanagunawardena, T. R., Adams, A. A., & Williams, S. A. (2013). MOOCs: A Systematic Study of the Published Literature 2008-2012. *International Review of Research in Open and Distance Learning*, *14*(3), 202–227. doi:10.19173/irrodl.v14i3.1455

Liyanagunawardena, T. R., & Williams, S. A. (2014). Massive Open Online Courses on Health and Medicine [Review]. *Journal of Medical Internet Research*, *16*(8), e191. doi:10.2196/jmir.3439 PMID:25123952

Lopez-Meneses, E., Vazquez-Cano, E., & Roman, P. (2015). Analysis and Implications of the Impact of MOOC Movement in the Scientific Community: JCR and Scopus (2010-13). *Comunicar*, *22*(44), 73–80. doi:10.3916/C44-2015-08

Macleod, H., Haywood, J., Woodgate, A., & Alkhatnai, M. (2015). Emerging patterns in MOOCs: Learners, course designs and directions. *TechTrends*, *59*(1), 56–63. doi:10.1007/s11528-014-0821-y

Murray, D. J. A. (2014). Participants' perceptions of a MOOC. *Insights*, *27*(2), 154–159. doi:10.1629/2048-7754.154

Najafi, H., Evans, R., & Federico, C. (2014). MOOC Integration into Secondary School Courses. *International Review of Research in Open and Distance Learning*, *15*(5), 306–322. doi:10.19173/irrodl.v15i5.1861

Nisha, F., & Senthil, V. (2015). MOOCs: Changing trend towards open distance learning with special reference to India. *DESIDOC Journal of Library and Information Technology*, *35*(2), 82–89. doi:10.14429/djlit.35.2.8191

Nkuyubwatsi, B. (2014). A cross-modal analysis of learning experience from a learner's perspective. *Electronic Journal of e-Learning, 12*(2), 195-205.

Nyoni, J. (2013). The viral nature of massive open online courses (MOOCs) in open and distance learning: Discourses of quality, mediation and control. *Mediterranean Journal of Social Sciences*, *4*(3), 665–672.

O'Malley, P. J., Agger, J. R., & Anderson, M. W. (2015). Teaching a Chemistry MOOC with a Virtual Laboratory: Lessons Learned from an Introductory Physical Chemistry Course. *Journal of Chemical Education*, *92*(10), 1661–1666. doi:10.1021/acs.jchemed.5b00118

Perez, M. E. D. M., & Guzman-Duque, A.-P. (2015). Communities of endogenous and exogenous learning created around the university MOOCs. *Campus Virtuales*, *4*(2), 78–85.

Perna, L. W., Ruby, A., Boruch, R. F., Wang, N., Scull, J., Ahmad, S., & Evans, C. (2014). Moving Through MOOCs: Understanding the Progression of Users in Massive Open Online Courses. *Educational Researcher*, *43*(9), 421–432. doi:10.3102/0013189X14562423

Redfield, R. J. (2015). Putting my money where my mouth is: The Useful Genetics project. *Trends in Genetics*, *31*(4), 195–200. doi:10.1016/j.tig.2015.02.004 PMID:25769728

Ruby, A., Perna, L., Boruch, R., & Wang, N. (2015). Are there metrics for MOOCS from social media? *Journal of Asynchronous Learning Networks*, *19*(5), 159–170.

Schmid, L., Manturuk, K., Simpkins, I., Goldwasser, M., & Whitfield, K. E. (2015). Fulfilling the promise: Do MOOCs reach the educationally underserved? *Educational Media International*, *52*(2), 116–128. doi:10.1080/09523987.2015.1053288

Searls, D. B. (2014). A New Online Computational Biology Curriculum. *PLoS Computational Biology*, *10*(6), 1–3. doi:10.1371/journal.pcbi.1003662 PMID:24921255

Severance, C. (2015). Anant Agarwal: Inside edX. *The IEEE Computer Society*, *48*(10), 8–9. doi:10.1109/MC.2015.308

Soffer, T., & Cohen, A. (2015). Implementation of Tel Aviv University MOOCs in Academic Curriculum: A Pilot Study. *International Review of Research in Open and Distance Learning*, *16*(1), 80–97. doi:10.19173/irrodl.v16i1.2031

Subhi, Y., Andresen, K., Bojsen, S. R., Nilsson, P. M., & Konge, L. (2014). Massive open online courses are relevant for postgraduate medical training. *Danish Medical Journal*, *61*(10), 1–5. PMID:25283619

Toven-Lindsey, B., Rhoads, R. A., & Lozano, J. B. (2015). Virtually unlimited classrooms: Pedagogical practices in massive open online courses. *Internet and Higher Education, 24*.

Tschofen, C., & Mackness, J. (2012). Connectivism and dimensions of individual experience. *International Review of Research in Open and Distance Learning*, *13*(1), 124–143. doi:10.19173/irrodl.v13i1.1143

Vazquez-Cano, E. (2013). The Videoarticle: New Reporting Format in Scientific Journals and its Integration in MOOCs. *Comunicar*, *21*(41), 83–90. doi:10.3916/C41-2013-08

Woodgate, A., Macleod, H., Scott, A.-M., & Haywood, J. (2015). Differences in online study behaviour betwwen sub-populations of MOOC learners. *Educacion XX1, 18*(2), 147-163.

Yousef, A. M. F., Chatti, M. A., Wosnitza, M., & Schroeder, U. (2015). A cluster analysis of MOOC stakeholder perspectives. *RUSC Universities and Knowledge Society Journal*, *12*(1), 74–90. doi:10.7238/rusc.v12i1.2253

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